

## CLAIMS:

1. Water heating apparatus including:
  - a storage tank for storing heated water;
  - 5 a gas burner assembly for heating water in the tank;
  - the gas burner assembly including:
    - a housing;
    - a gas burner in the housing;
    - 10 at least one passage through the housing; and
    - mounting means for mounting the housing in the tank such that, in use, it is immersed in water within the tank and wherein, when the gas burner is operated, the temperature of the housing rises and heat transfer to the water in the tank occurs and a convection current in said water flows through said at least one passage to thereby increase heat transfer to the water.
- 15 2. Water heating apparatus as claimed in claim 1 wherein there are a plurality of said passages extending through said housing.
3. Water heating apparatus as claimed in claim 2 wherein the housing includes a cylindrical housing sidewall and top and bottom housing end walls, and wherein said 20 passages are defined by tubular elements which extend between said housing top and bottom walls.
4. Water heating apparatus as claimed in claim 3 wherein the housing bottom wall is 25 inclined at a predetermined angle to the horizontal.
5. Water heating apparatus as claimed in claim 4 wherein the predetermined angle is in the range 1° to 5°.
- 30 6. Water heating apparatus as claimed in claim 5 wherein the predetermined angle is 2.5°.

7. Water heating apparatus as claimed in claim 4 wherein the tank includes a cylindrical tank sidewall and top and bottom tank end walls and wherein the axis of the cylindrical housing sidewall is inclined at said predetermined angle relative to the axis of the cylindrical tank sidewall.

5 8. Water heating apparatus as claimed in claims 1 to 7 wherein the tank includes a heat exchanger located above the burner assembly and coupling means for connecting a mains water supply to the heat exchanger so that water from said supply passes through the heat exchanger and is heated by extraction of heat from the water stored in the tank.

10 9. Water heating apparatus as claimed in claim 8 wherein the heat exchanger includes a coil.

10 10. Water heating apparatus as claimed in claim 8 wherein the heat exchanger includes 15 two coils connected in parallel.

11. Water heating apparatus as claimed in claim 9 or 10 wherein said coil or coils are helically wound about an axis which passes through or near to the centre of said housing.

20 12. Water heating apparatus as claimed in claim 8, 9 or 10 wherein convection currents passing through said passage or passages impinge upon said heat exchanger and wherein, as heat is absorbed into the heat exchanger, cool convection currents are established, said cool convection currents flow downwardly at a location between the heat exchanger and the tank.

25 13. Water heating apparatus as claimed in claim 12 including a gas control valve for controlling flow of gas to the gas burner, a temperature sensor having an output coupled to said gas control valve, the arrangement being such that gas is supplied to the gas burner when the temperature sensor senses that the temperature of the water is below an operating 30 temperature.

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14. Water heating apparatus as claimed in claim 13 wherein the temperature sensor is located below said housing.

15. Water heating apparatus as claimed in claim 13 or 14 wherein the sensor is located  
5 adjacent to a sidewall of the tank.

16. Water heating apparatus as claimed in claim 13, 14 or 15 wherein the sensor is located in a position such that in use said cool convection currents impinge upon said sensor.

10 17. Water heating apparatus as claimed in claims 13 to 16 including an over temperature sensor which is operable in use to stop supply of gas to the gas burner wherein a predetermined over temperature is reached in the tank.

15 18. Water heating apparatus as claimed in claim 17 wherein the gas burner assembly includes a flue which extends upwardly from said housing.

19. Water heating apparatus as claimed in claim 17 wherein the over temperature sensor is mounted so that it is in the tank and in thermal contact with said flue, the  
20 arrangement being such that the over temperature sensor is operable to stop supply of gas to the gas burner when the water in the tank exceeds said predetermined over temperature or the tank includes air in the top thereof whereby the flue will cause the over temperature sensor to sense a temperature greater than said predetermined over temperature.

25 20. Water heating apparatus as claimed in claim 3 wherein a plurality of reinforcing rods extend between housing top and bottom walls.

21. Water heating apparatus as claimed in claim 20 wherein said rods pass through said tubular elements.

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22. Water heating apparatus as claimed in claims 1 to 21 including a header tank located above said storage tank, a first water conduit extending from the top of the storage tank to an upper part of the header tank and a second conduit extending from a lower part of the header tank to a lower part of the storage tank.

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23. Water heating apparatus as claimed in claim 22 including air bubble directing means for directing air bubbles in the water in the storage tank to said first conduit so that air bubbles are removed from the storage tank.

10 24. Water heating apparatus as claimed in claim 22 as appended indirectly to claim 7 wherein the tank top wall is inclined to the horizontal and the first conduit is connected to an uppermost part of said tank top wall to thereby constitute said means for directing air bubbles.

15 25. Water heating apparatus as claimed in claim 22, 23 or 24 as appended directly or indirectly to claim 8 including a heat exchanger pressure relief valve which is coupled to discharge into said header tank.

20 26. Water heating apparatus as claimed in claim 25 including a header tank pressure relief valve which is operable to discharge if the pressure within the header tank, and therefore the storage tank, exceeds a predetermined operating pressure.

27. Water heating apparatus as claimed in claim 26 wherein the operating pressure is about 50 psi.

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28. A gas/solar water heating apparatus including:  
water heating apparatus as claimed in any one of claims 8 to 21;  
a solar collector panel;  
a solar storage tank;  
30 circulating means for circulating water from the solar storage tank to the panel;  
a heat exchanger in the solar storage tank; and

said coupling means being operable to pass water from said water supply through the heat exchanger in said solar storage tank prior to passing through the heat exchanger in said storage tank.

5 29. A gas/solar water heating apparatus as claimed in claim 28 wherein the solar storage tank is located beneath said storage tank and within a single housing.

30. A gas/solar water heating apparatus as claimed in claim 29 including flue gas circulating means for directing flue gases from the burner assembly to said solar storage 10 tank, whereby heat in said flue gases is absorbed into the water in the solar storage tank.

31. A gas/solar water heating system including:  
a gas fired water heater having a flue;  
a solar collector panel;  
15 a solar storage tank;  
circulating means for circulating water from the solar storage tank to the panel;  
a heat exchanger in the solar storage tank; and  
said solar collector panel including a flue gas chamber therein and flue gas ducting means for coupling said flue to the flue gas chamber, the arrangement being such that  
20 water circulated through the panel absorbs solar energy and heat energy from flue gases entering the chamber.

32. A gas/solar water heating system as claimed in claim 31 including control means operable to control ignition of said gas fired water heater and said circulating means, the 25 control means being operable to operate the circulating means prior to ignition of said gas fired water heater so that the flue gases do not overheat the panel.

33. Electrical power and hot water heating apparatus including:  
a gas/solar water heating system as claimed in claim 31;  
30 an internal combustion engine having an exhaust;  
an electric generator coupled to be driven by said internal combustion engine; and

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exhaust gas duct means for directing exhaust gases into said flue gas chamber whereby the water circulated through the panel absorbs heat from said exhaust gases.

34. Apparatus as claimed in claim 33 wherein said exhaust gas duct means includes a 5 venturi and wherein the end of said flue gas ducting means is located in said venturi.

35. Hot water heating apparatus including:

a gas/solar water heating system as claimed in claim 31;  
an internal combustion engine having an exhaust; and

10 exhaust gas duct means for directing exhaust gases into said flue gas chamber whereby the water circulated through the panel absorbs heat from said exhaust gases.

36. Apparatus as claimed in claim 35 wherein said exhaust gas duct means includes a venturi and wherein the end of said flue gas ducting means is located in said venturi.

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